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DEPARTMENT OF PHYSICS

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WASHINGTON, D.C. 20001

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INTRODUCTION

The subject of this research is twofold, (1) to compare the water content of tektites and terrestrial glasses and (2) to establish whether or not submicroscopic magnetic particles exist in tektites. The information found in (1) and (2) will shed further evidence as to the origin of tektites.

Water in Tektites

An infra-red absorption technique is being devised to determine the water content of tektite glass. Water absorbs strongly at 2.93 microns in the infra-red spectrum and the absorption band can be used to determine the water content if a standardized technique is used. A high resolution Perkin-Elmer single beam double-pass instrument is currently being used for this work. The specimens are polished slices about 0.5 to 0.6 mm. thick. The thickness of the specimens is accurately measured using a microscope technique. The samples are washed and placed in a sliding sample holder so that they can be placed in and out of the beam quickly. The difference measurement thus gives an absolute absorption of the specimen. By using different masks, a sample area of $3 \times 10^{-2} cm^2$ to $3 \times 10^{-1} cm^2$ is used for the absorption measurements.

To calibrate the instrument, about twenty tektite and obsidian specimens which have previously been measured for water by a mass-spectrometer technique are being used (See Friedman, 1958 and Friedman and Smith, 1958). The water absorption constant (α') for a particular wavelength is determined from the transmission data. It is well known that the following equation is correct to a first approximation:

$$T = e^{-\alpha' d}$$

where T is the absolute transmission, α' is the absorption constant and d is the thickness. Beer's law states that

$$\alpha' = C\alpha$$

where C is the concentration of the abosrbing species, and α is the absorption coefficient per unit of absorbing species. From a plot of α' vs. C, it appears that the water in both tektites and obsidians obeys Beer's law.

Table I shows the measurements which have been made to date, and the α' vs. C curve is shown in Figure 1. The individual spectra are shown in figures 2 through 11.

It is planned to measure about ten more analyzed tektites and obsidians to confirm the calibration curve. Once this has been established, it is planned to measure a number of tektites from each of the major strewn fields and also a selection of terrestrial glasses. Comparision of this data may point out significant features pertaining to the origin of tektites. For instance, it would be interesting to determine the water content of large Muong Nong type tektites as compared to other tektites. Also it would be desirable to know the relative water content of impactite glass as compared to tektites. Measurements would also be made on the water content near the surface of a tektite and the water content at the center of the tektite. It is possible that these measurements might confirm recent theoretical considerations (See O'Keefe, 1964).

Spherules in Tektites

A review of a number of x-ray diffraction patterns of tektites very frequently showed a weak α-iron line. This line while previously noted has been supposed to be due to iron contamination. However, in view of the small amount of metallic iron indicated by magnetic measurements of tektites (See Senftle, Thorpe and Lewis, 1964; Thorpe and Senftle, 1964), it may be possible that this α-iron line in the tektites is real and due to submicroscopic iron spherules. An obvious technique to check this possibility is low angle x-ray scattering measurements.

To see if this technique were worthwhile following in greater detail, several tektite specimens have been prepared and sent to Dr. Witz, Centre de Researches Sur les Macromolecules, Strasbourg, France. His results indicate that there were probably small iron spherules in the glass but that the volume fraction was of the order of 10^{-5} to 10^{-4}. This is about the same order of magnitude theorized by Thorpe and Senftle from magnetic measurements. These results look encouraging and are being analyzed to see if further work is warranted.

In the meantime, experiments are being made with the Mossbauer technique to see if it is possible to detect metallic iron in long term high resolution analysis, and also to determine the nature of the iron complex in tektite glasses. Figures 12 through 14 show typical data on two tektites and one obsidian. However, much more data is needed to solve these problems.

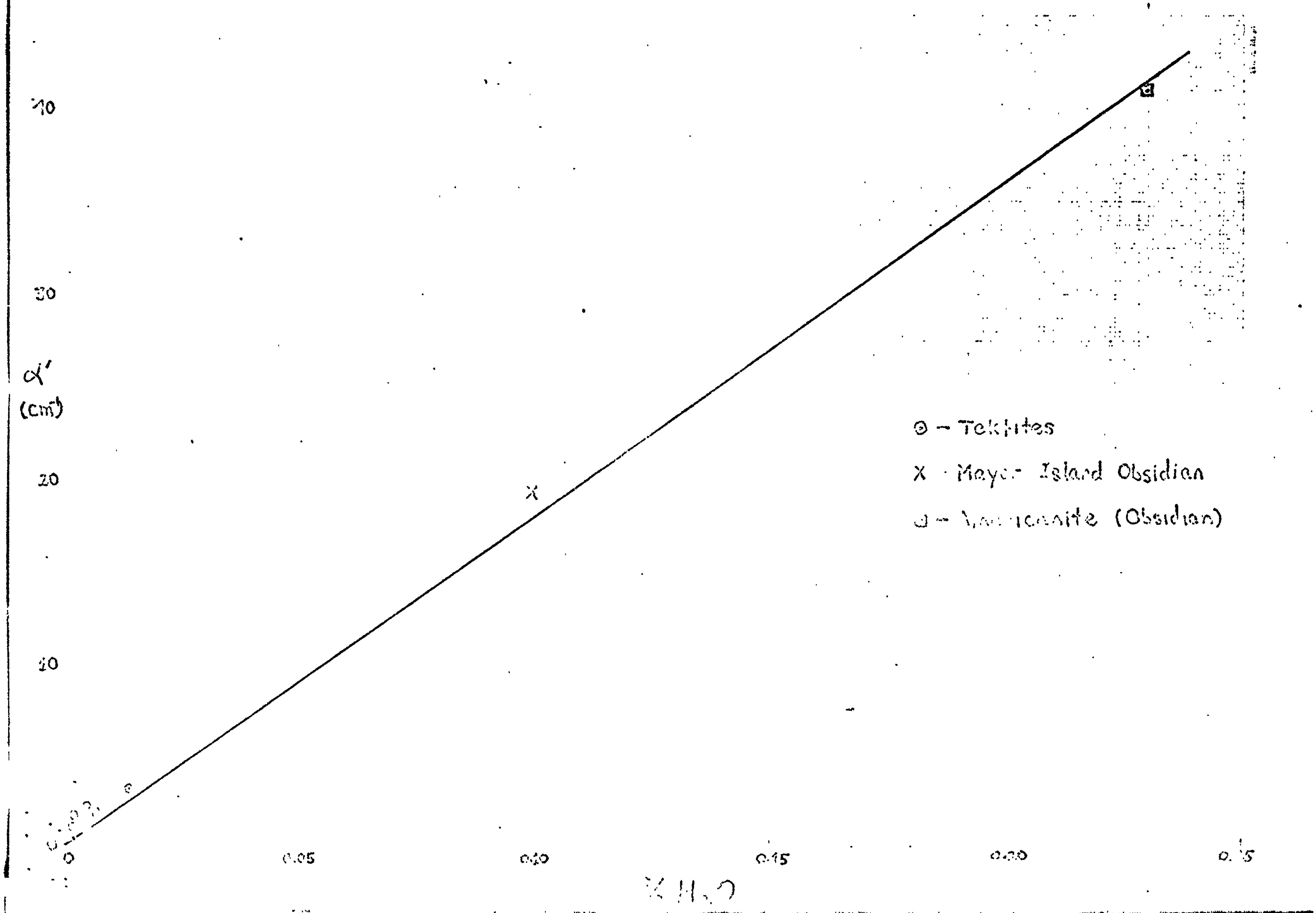
TABLE I

ABSORPTION COEFFICIENTS FOR TEKTITES AND OBSIDIANS

SAMPLE #	THICKNESS	α (cm^{-1})	$\% H_2O$
40-15	0.5880	2.020	0.005
43- 7	0.4082	2.203	0.005
96- 2	0.5820	3.367	0.014
97-9	0.5882	0.980	0.003
97- 2	0.6390	2.1435	0.005
41-15+	0.4821	42.0030	0.238
96- 9	0.4976	1.895	0.010
96-11	0.4748	1.080	0.002
27-17	0.4824	1.796	0.002
43- 4	0.4731	1.762	0.007
70- 9+	0.4698	19.670	0.100

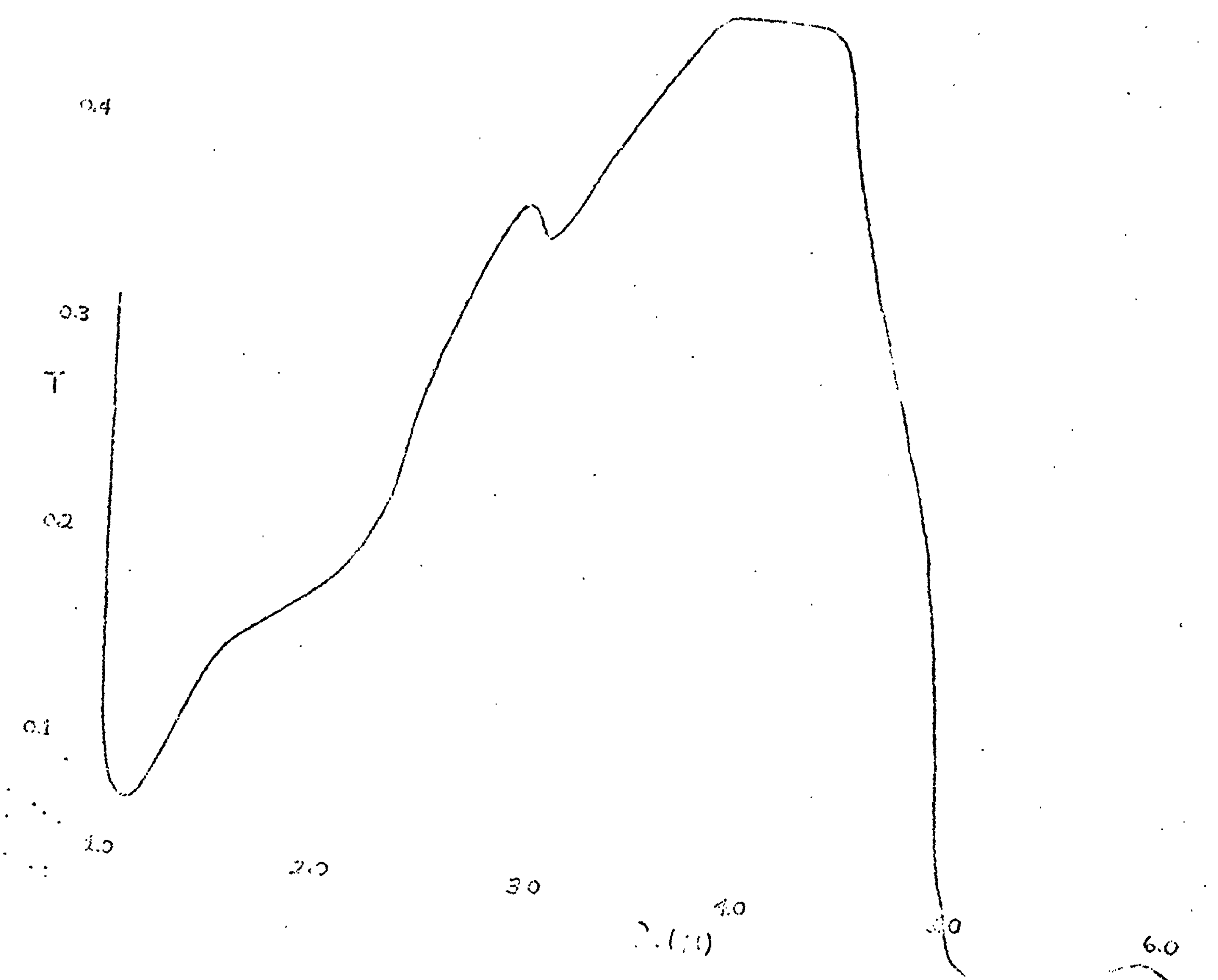
+Obsidian

Fig. 1



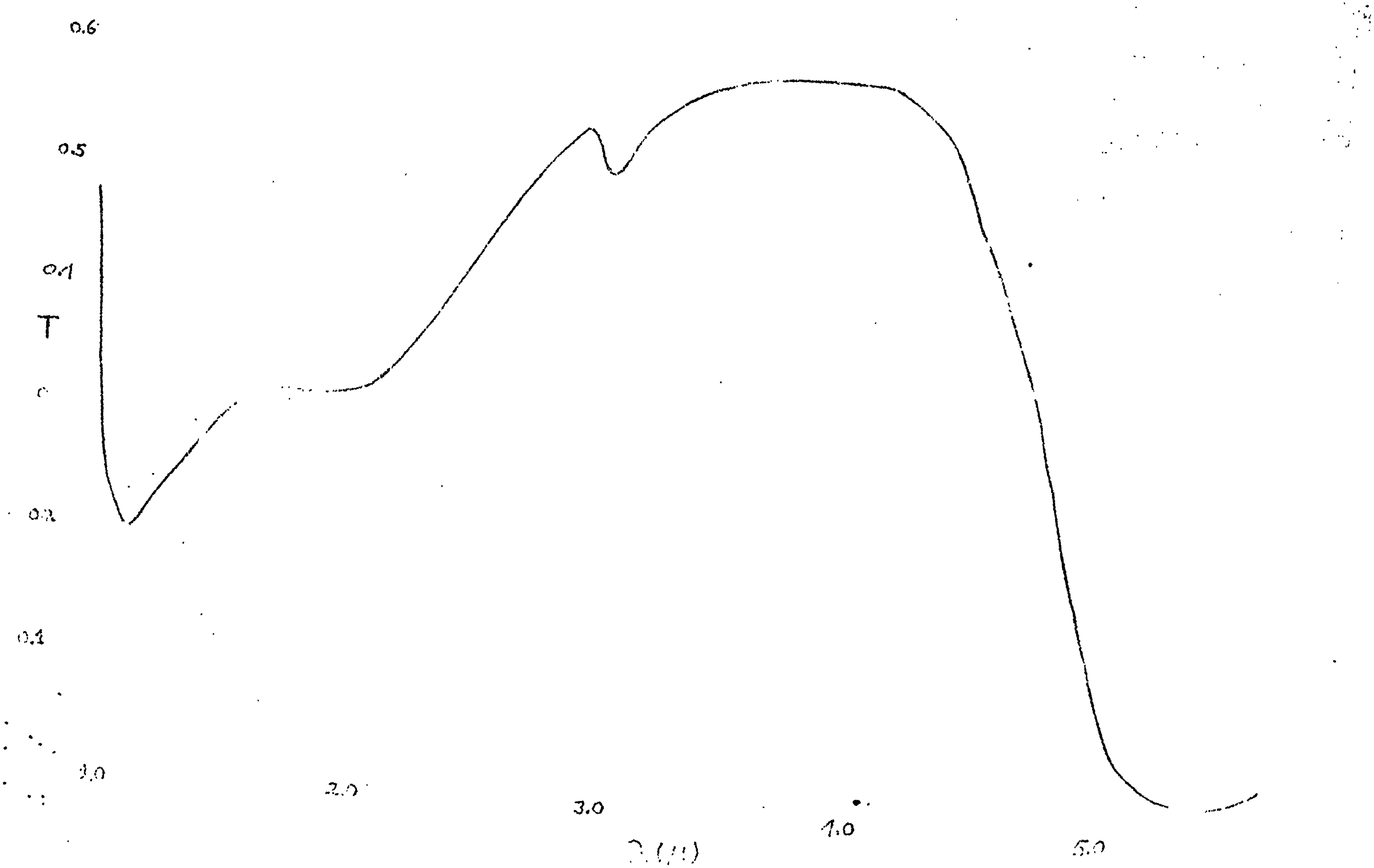
40
30
20
10
α′
(cm)
⊙ – Tektites
X · Mayor Island Obsidian
0
0.05
0.10
0.15
0.20
0.25
% H2O

Fig 2



43-7

Fig 3



#46-2

Fig 4

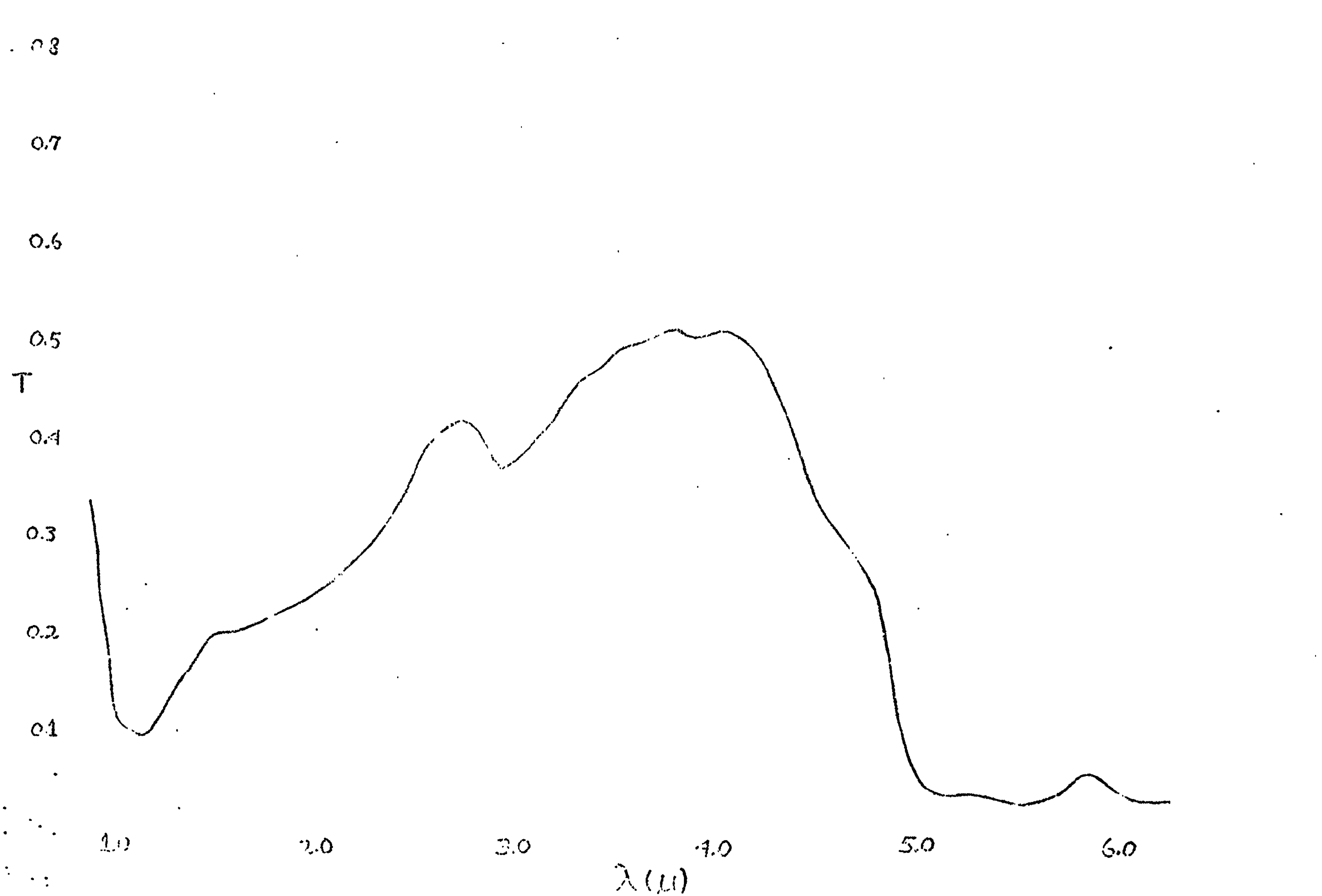
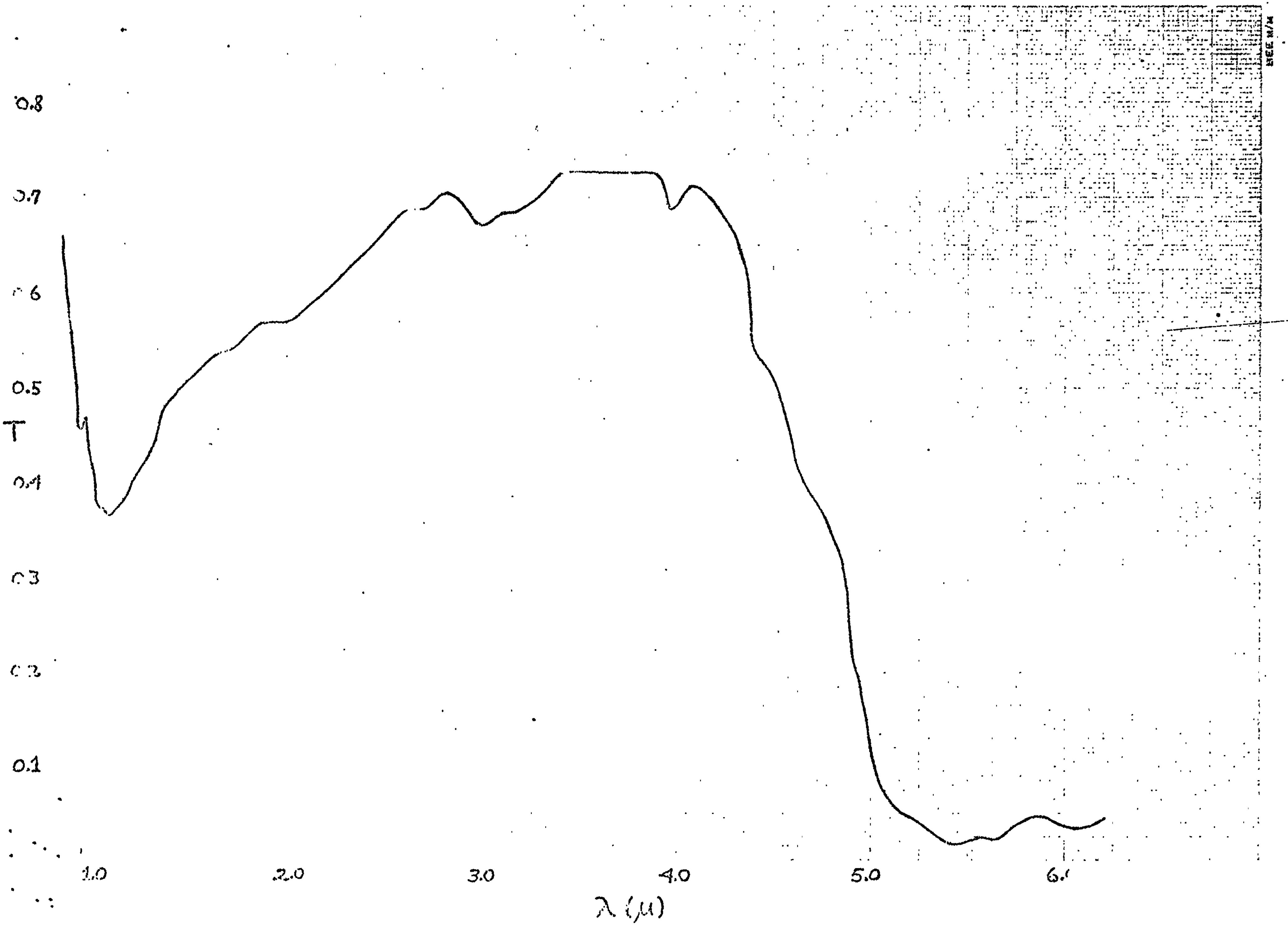
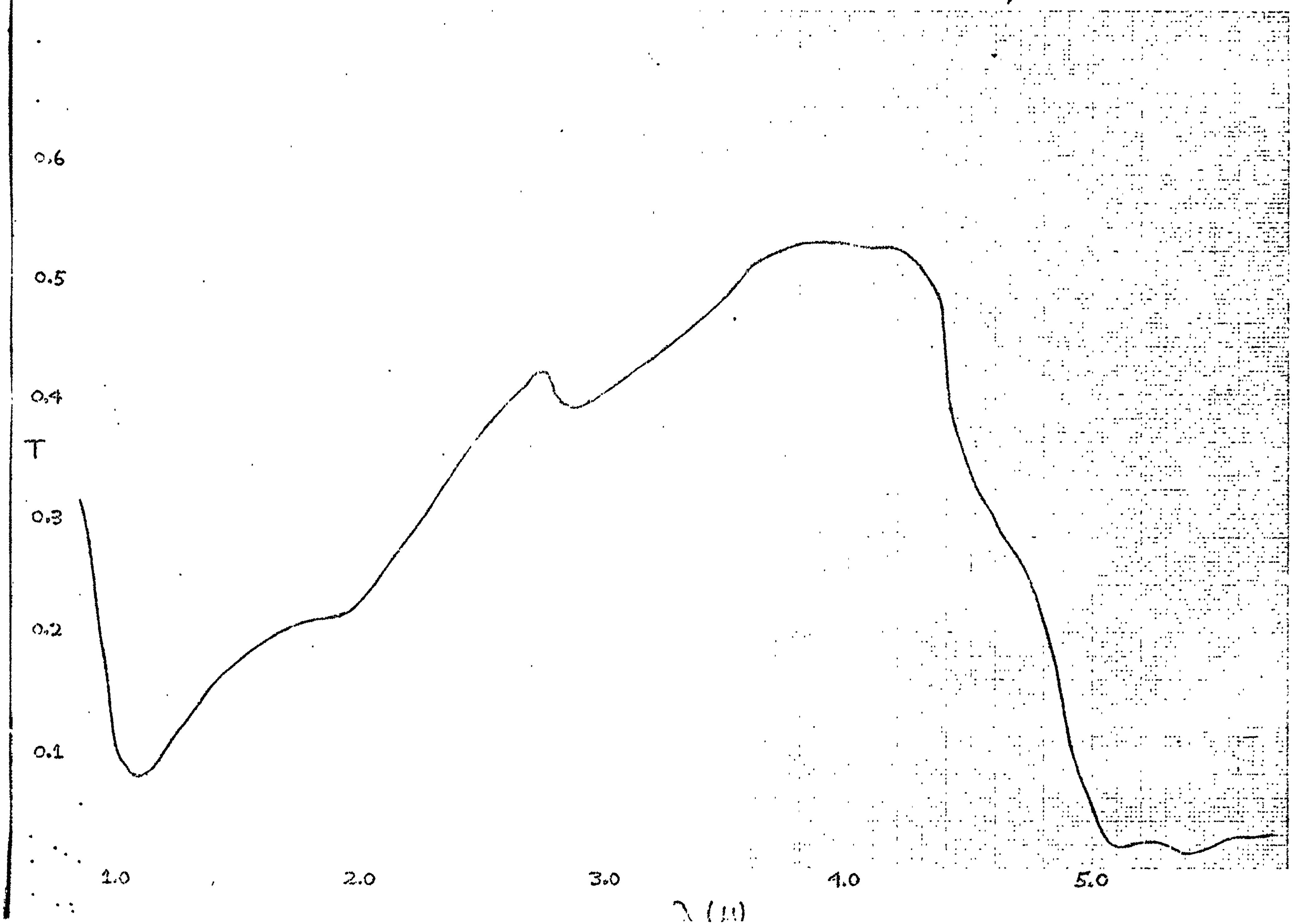


Fig 5



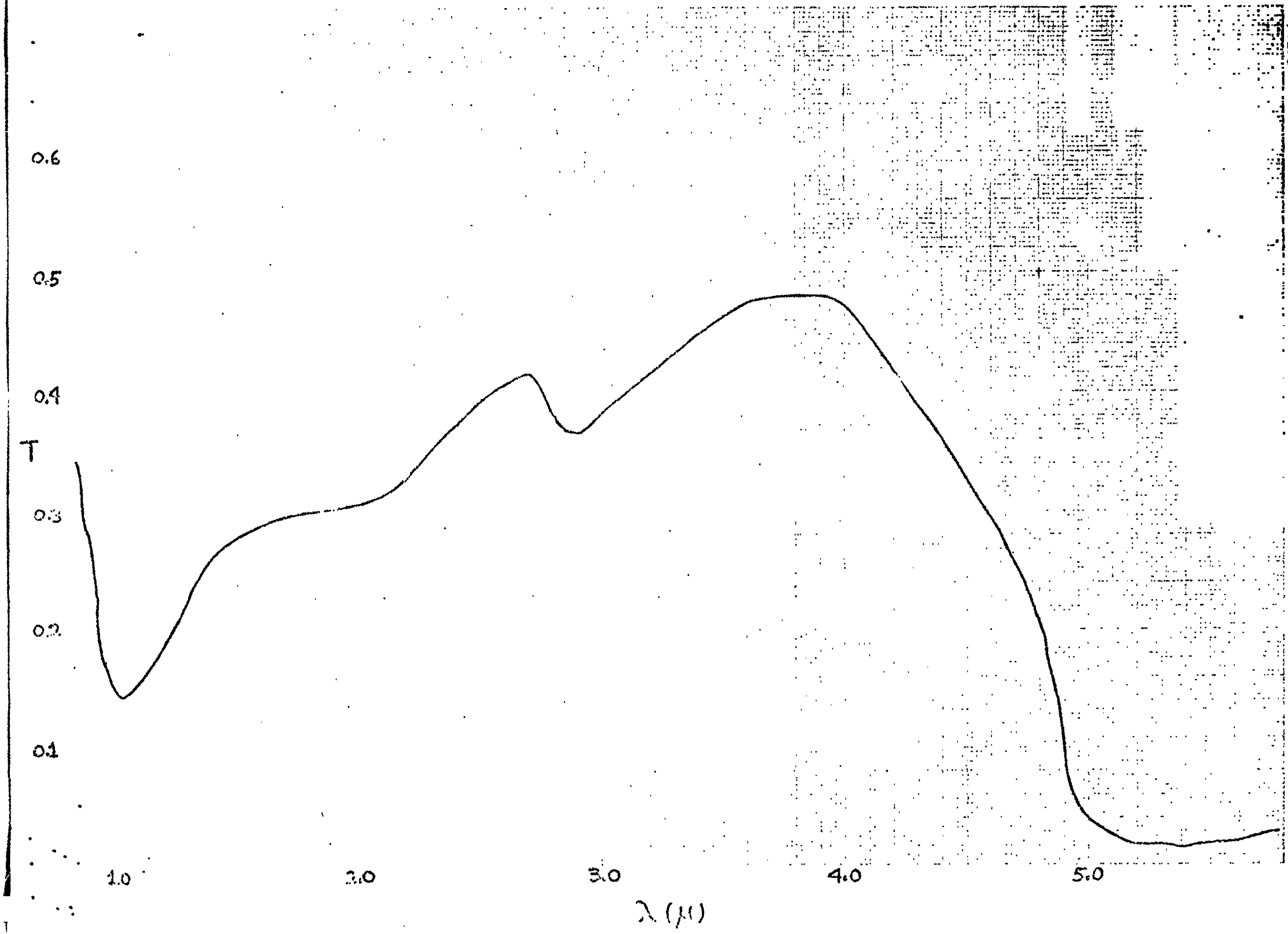
47-2

Fig 6



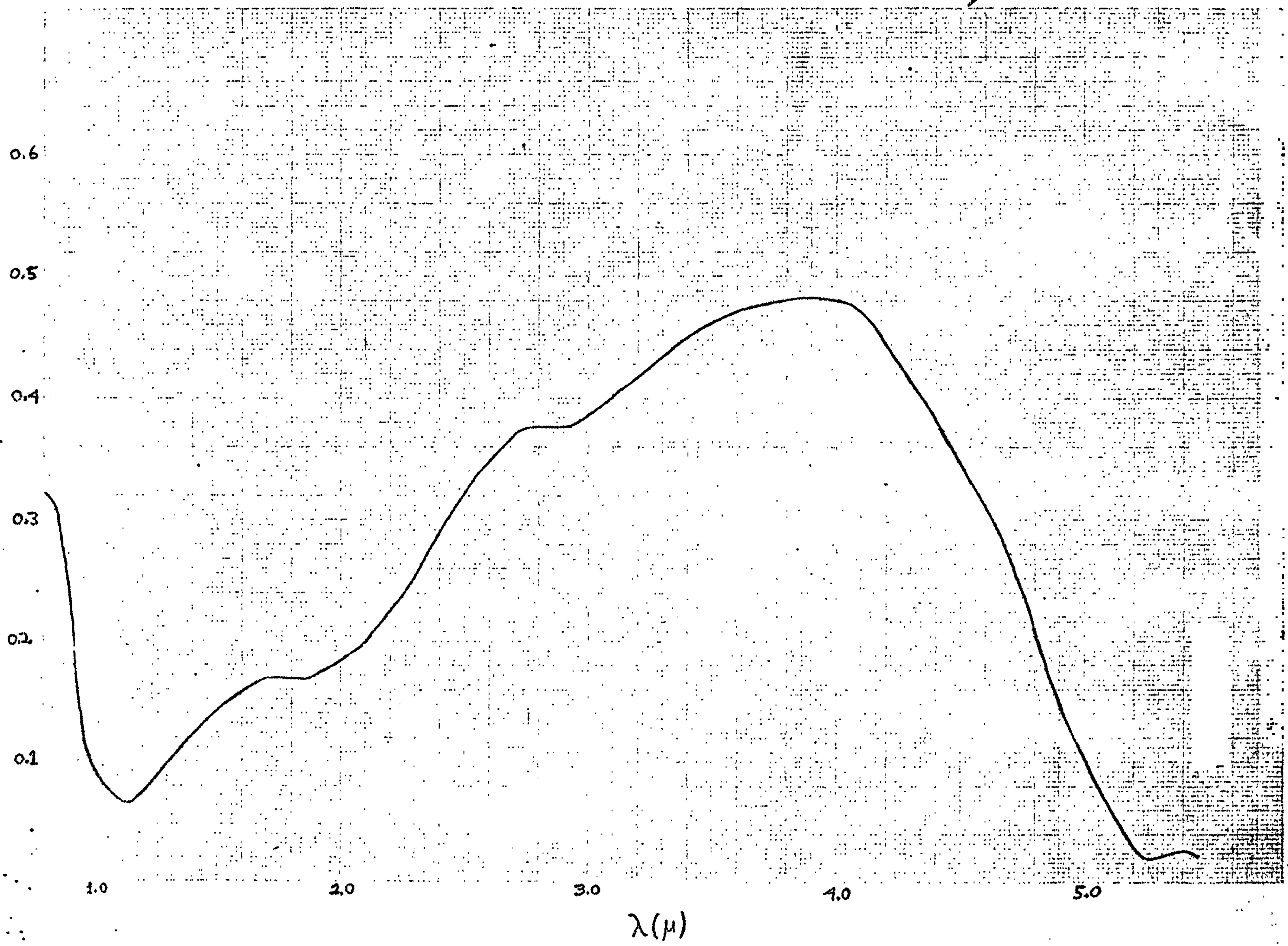
16 1

Fig 7

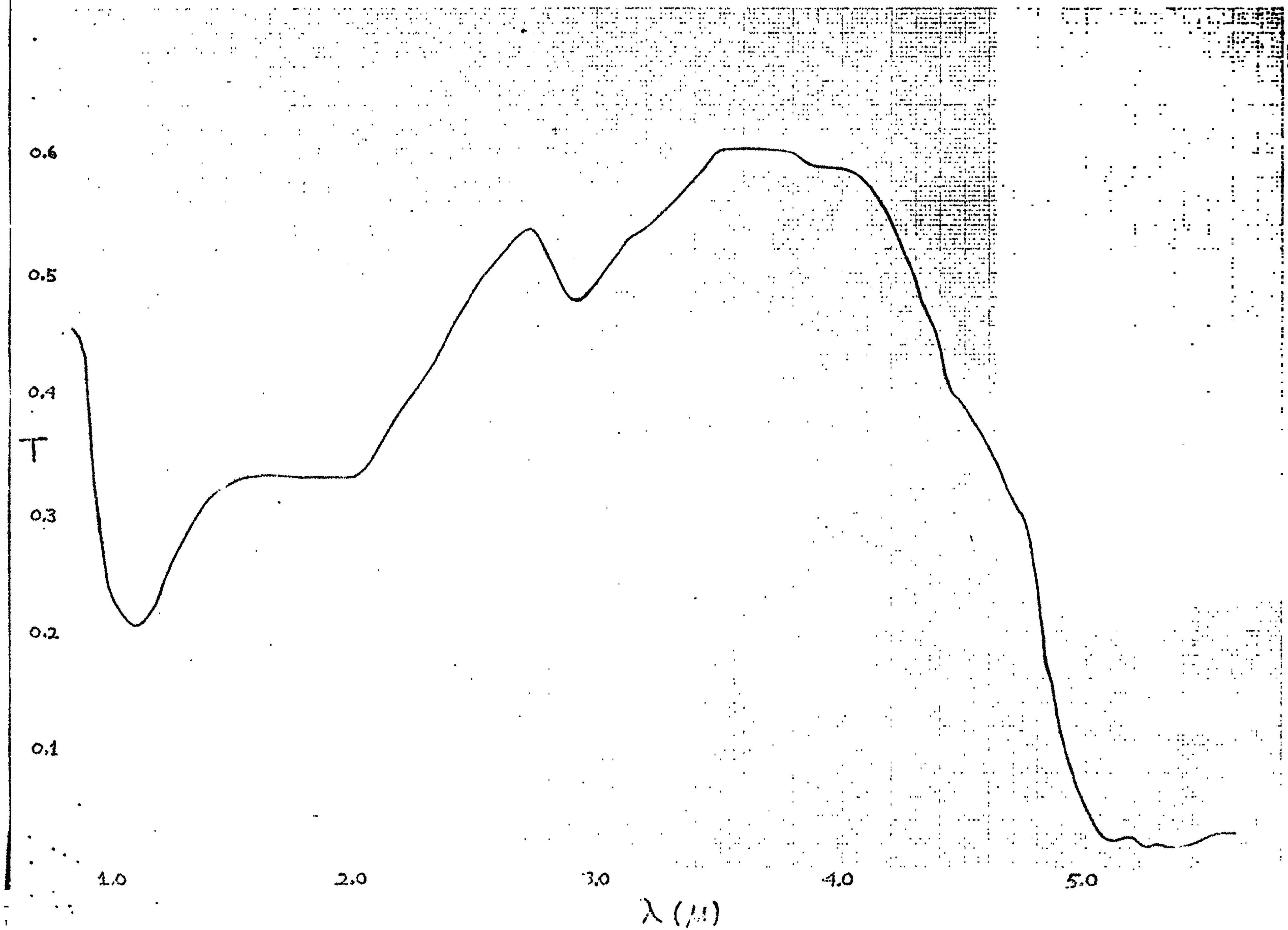


96-11

Fig 8

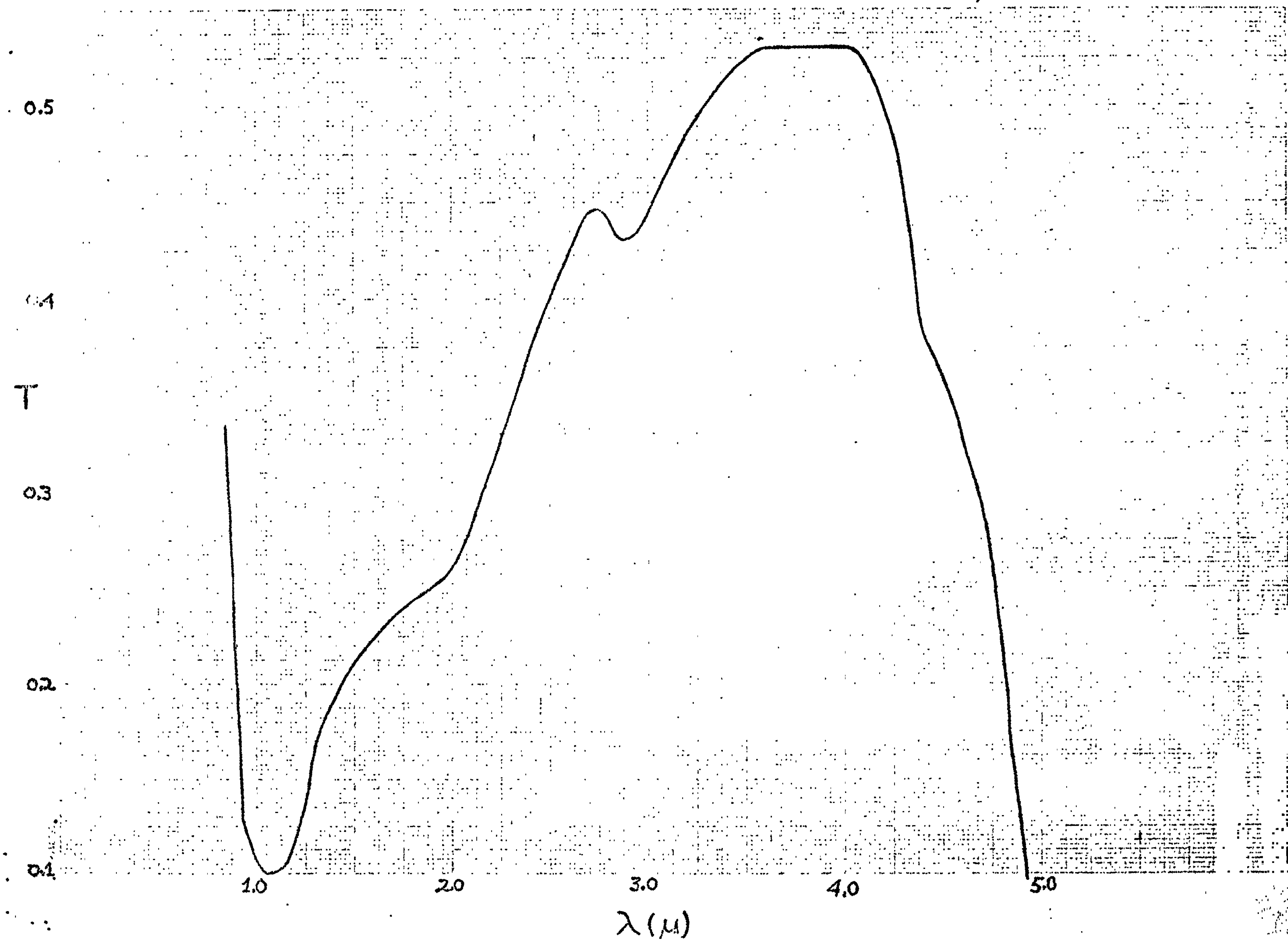


#21-11 Fig 9

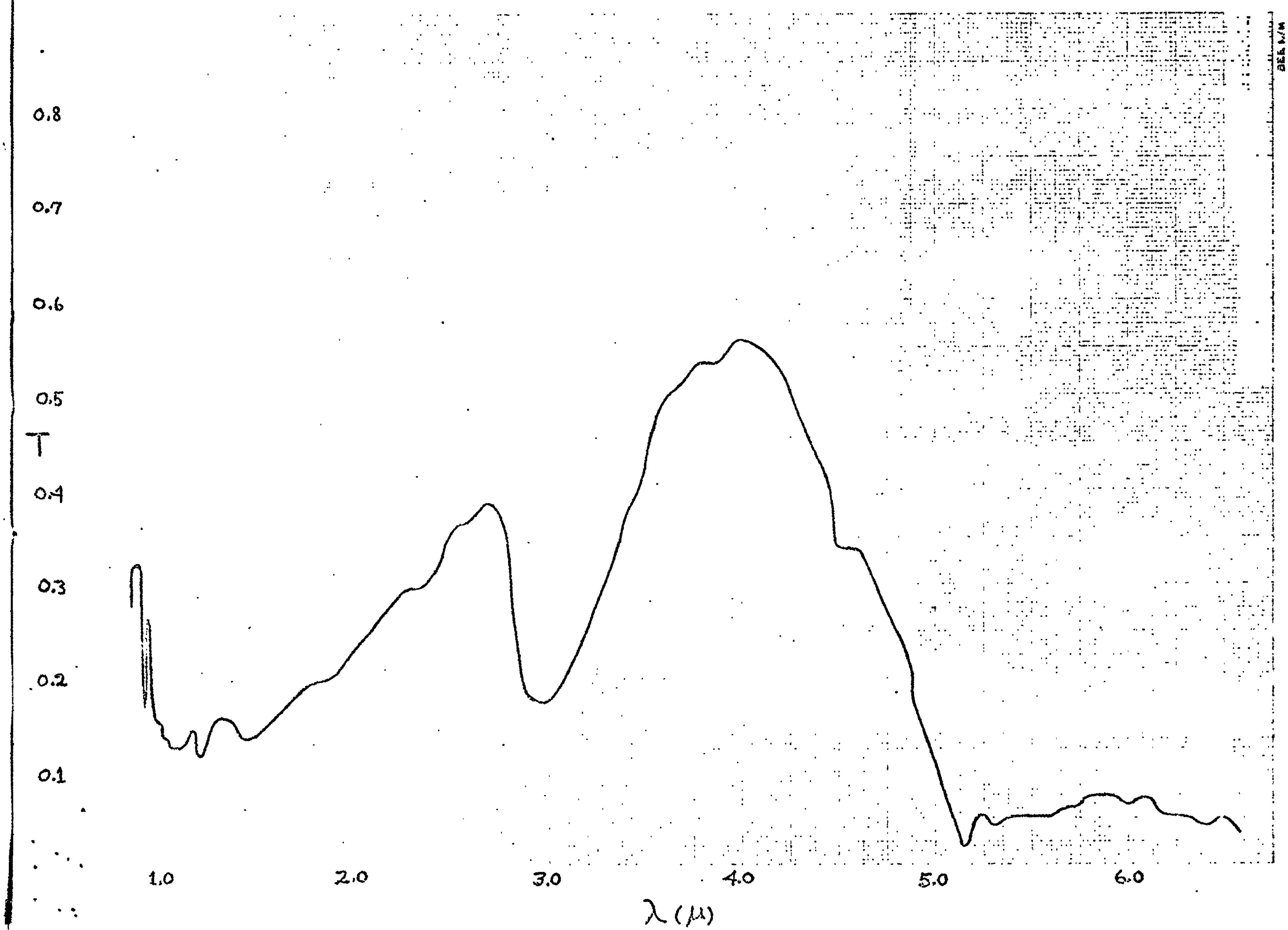


#43-4

Fig 10



llayor Island Obsidian



#41-15

Fig IIa

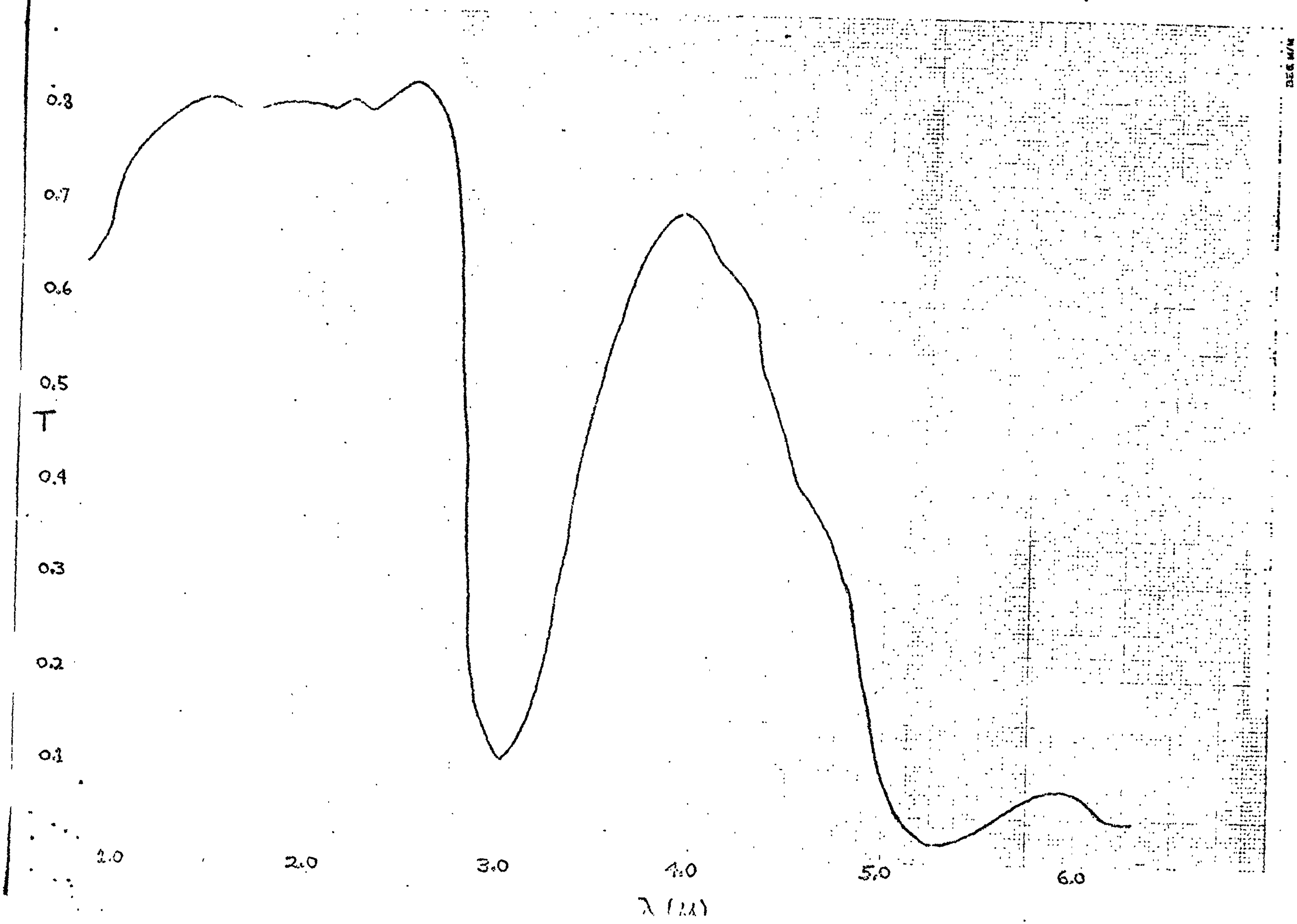
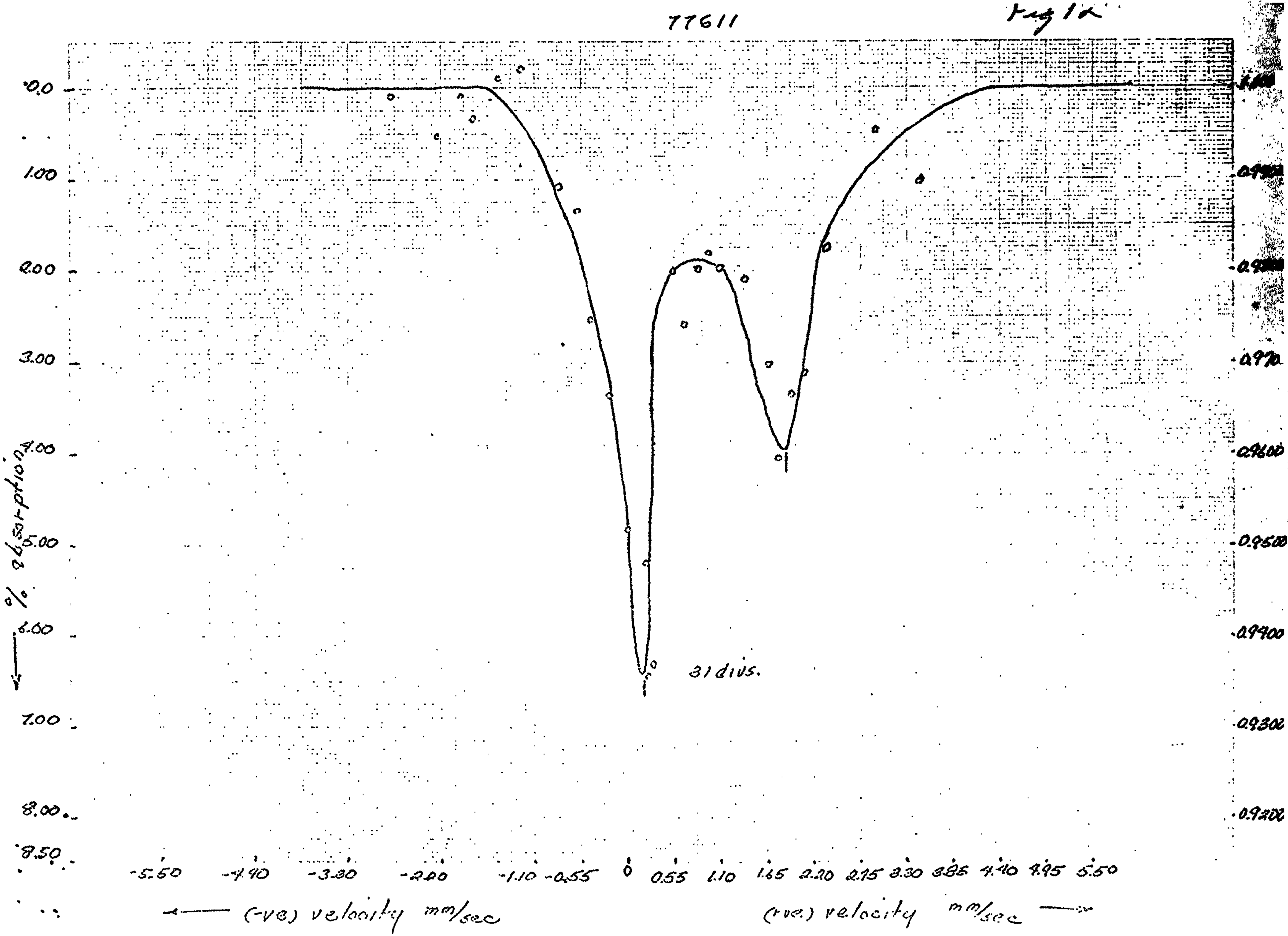


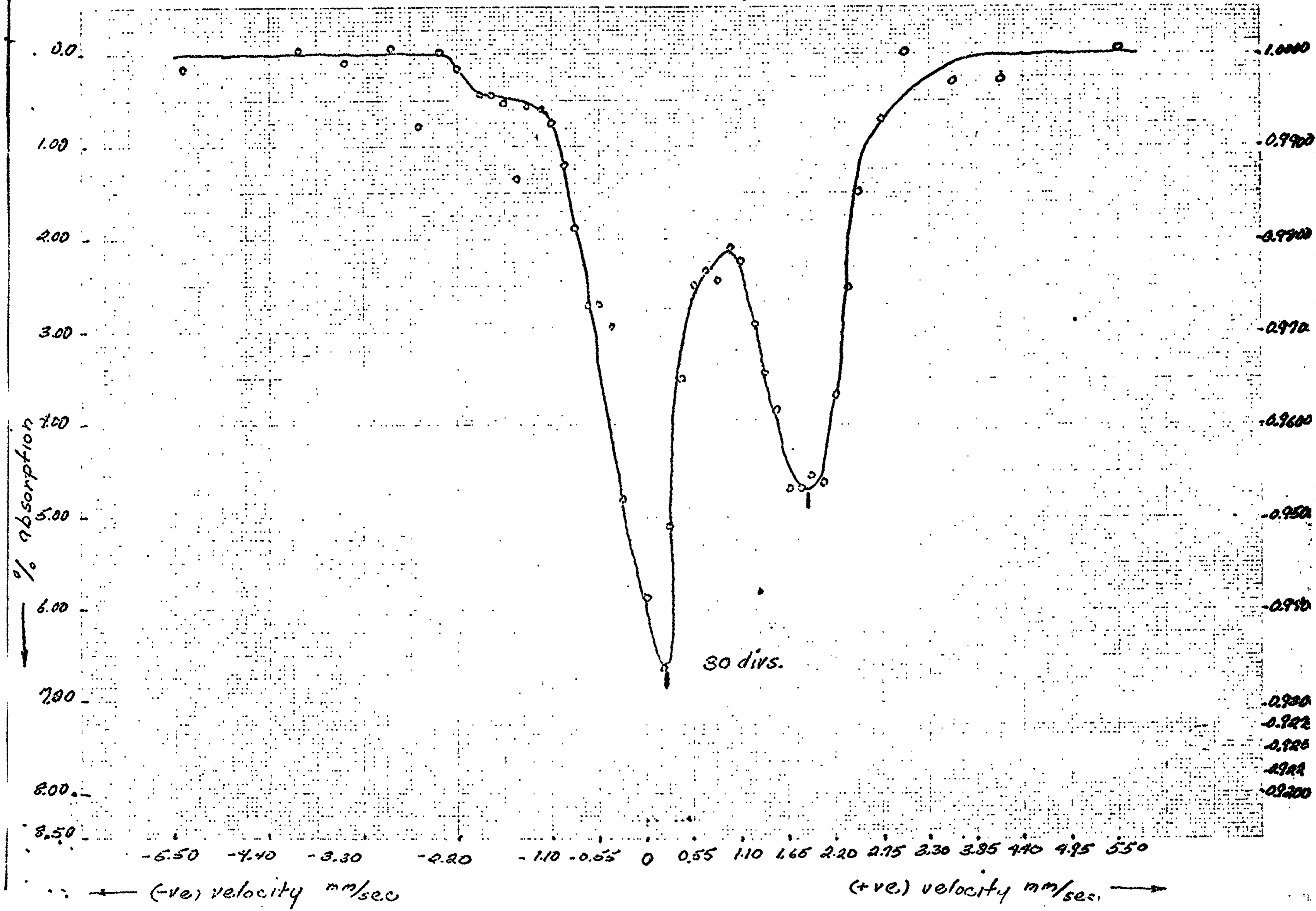
Fig 12



77611
31 divs.
0.0
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
8.50
% absorption
-5.50 -4.90 -3.30 -2.20 -1.10 -0.55 0 0.55 1.10 1.65 2.20 2.15 3.30 3.85 4.40 4.95 5.50
(-ve) velocity mm/sec
(+ve) velocity mm/sec
0.9700
0.9600
0.9500
0.9400
0.9300
0.9200

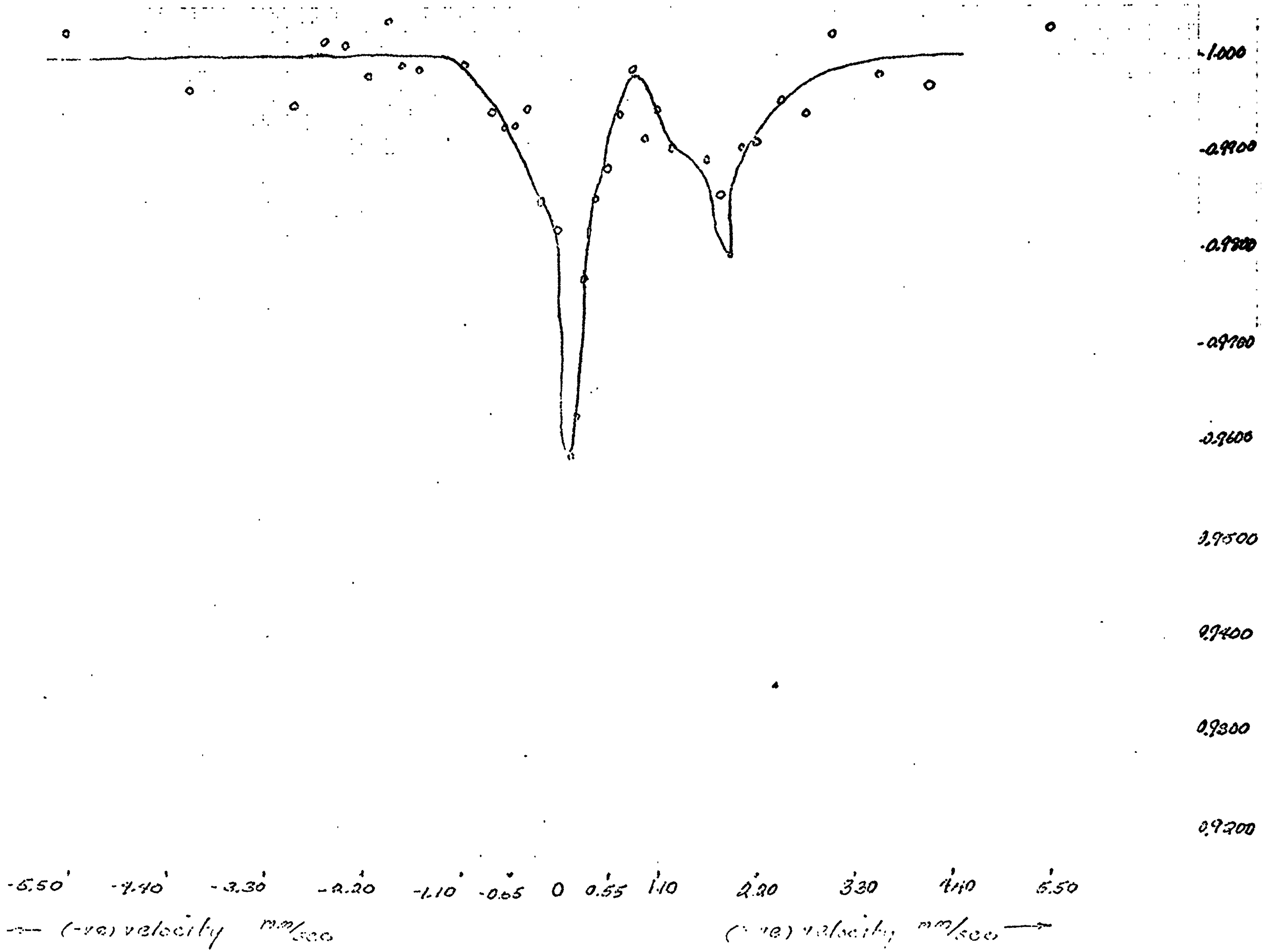
Fig 13

JS-11



0.0
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
8.50
% absorption
1.0000
0.9900
0.9800
0.970
0.9600
0.950
0.940
0.930
0.922
0.925
0.924
0.9200
30 divs.
-6.50 -4.40 -3.30 -2.20 -1.10 -0.55 0 0.55 1.10 1.65 2.20 2.75 3.30 3.85 4.40 4.95 5.50
(-ve) velocity mm/sec
(+ve) velocity mm/sec.

Major Island Obsidian #70-9 Fig 14



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